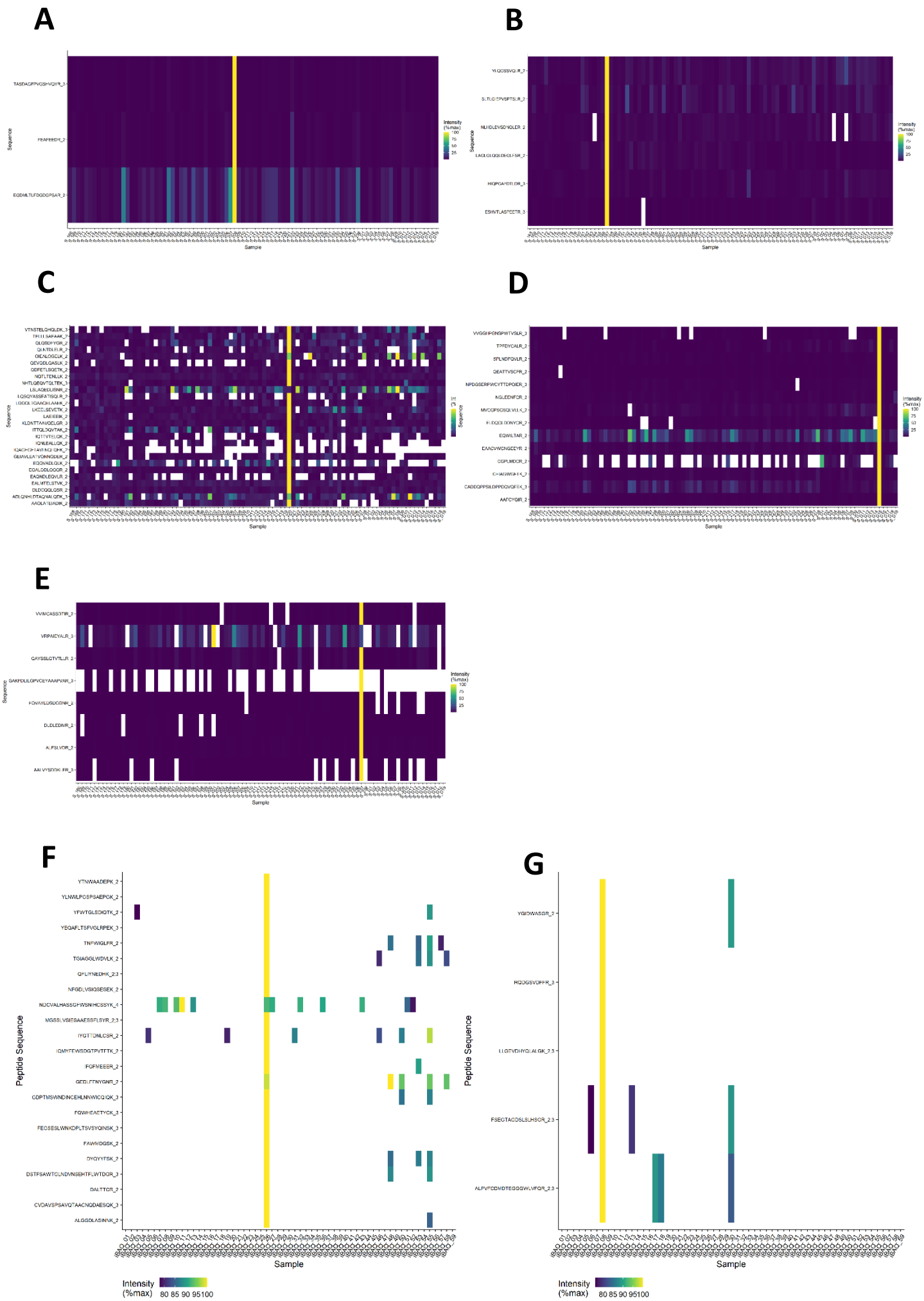
Supplemental Figure 1. Peptide heat maps of novel MN antigen candidates, demonstrating enrichment of unique antigen peptides in the index cases and not in other MN samples. A) SEZ6L2; B) VASN; C) EEA1; D) MST1; E) NPR3; F) FCN3; G) CD206. Heat maps from data collected by DIA (A-E) and DDA (F, G) are shown. Instances of missing values are colored white, and are more frequent in DDA data due to stochastic sampling.



Supplemental Figure 2. SEZ6L2 mass spectrometry data

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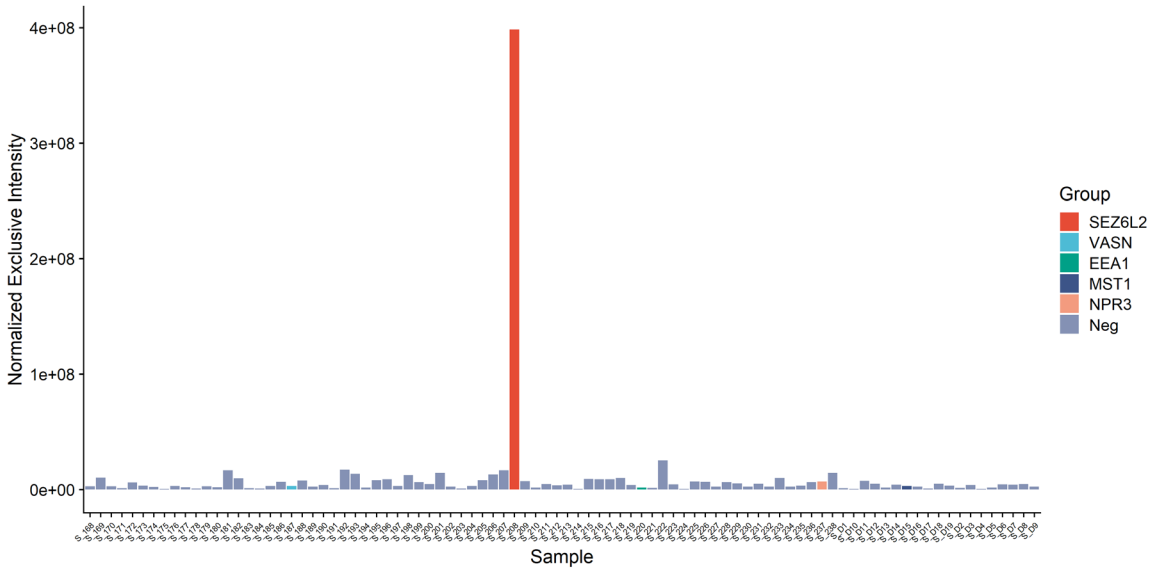

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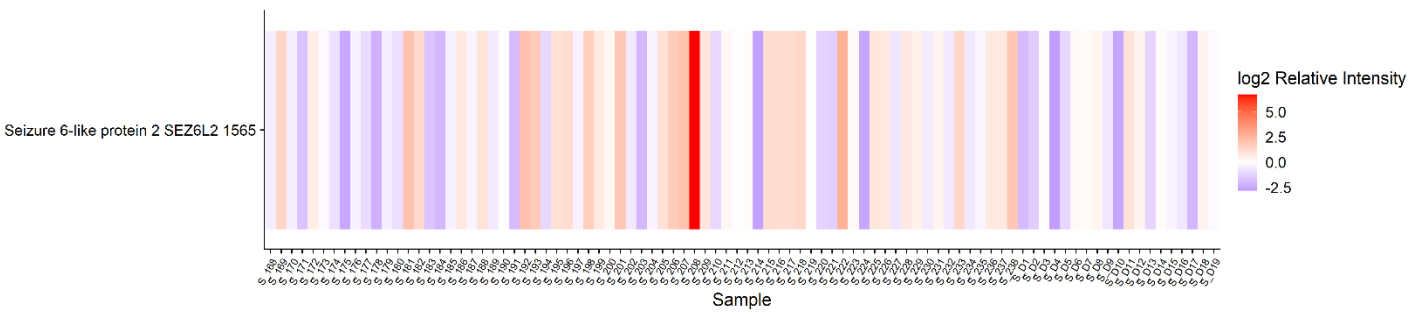

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Supplemental Figure 3. EEA1 mass spectrometry data

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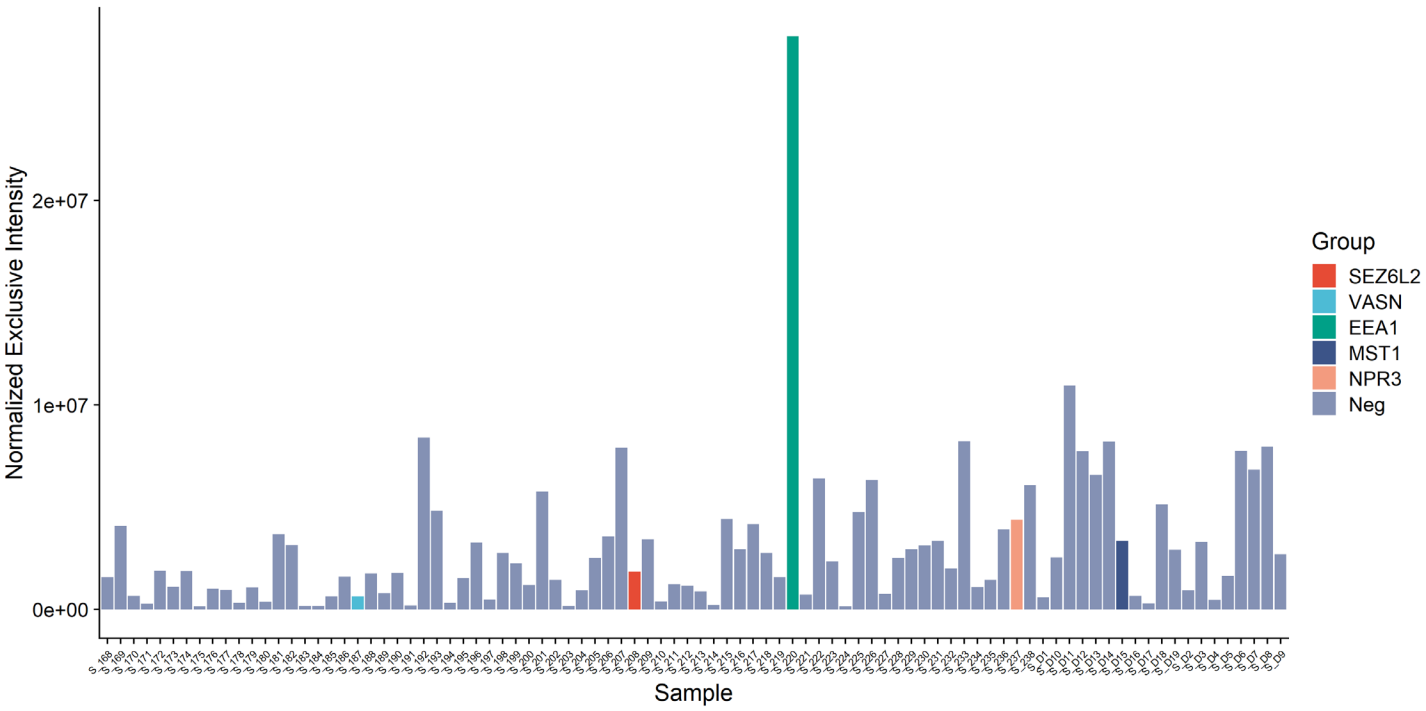

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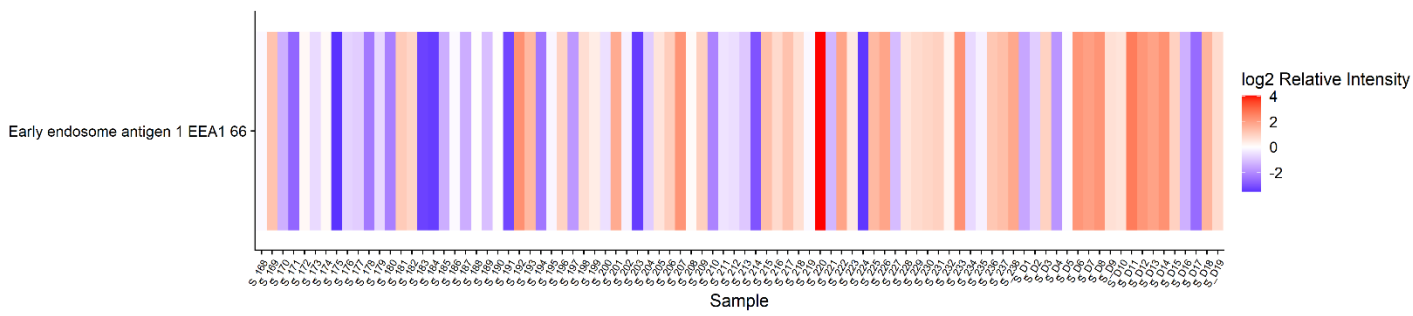

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FEQKAAQLAT EIADIKSKYD 180	QRADLQNHLD TAQNALQDKQ 680	LKDAKQLLIQ QKLELQGKAD 1180
EERSLREAAE QKVTRLTEEL 200	QELNKITTQL DQVTAKLQDK 700	SLKAAVEQEK RNQQILKDQV 1200
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HRIHVELSEK GEATQKLKEE 380	KLSKVSDSLK NSKSEFEKEN 880	CGKGFSVTVR RHHCRQCGNI 1380
LSEVETKYQH LKAEFKQLQQ 400	QKGKAAILDL EKTCKELKHQ 900	FCAECSAKNA LTPSSKKPVR 1400
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SKLLETERQL GEAHGRLKEQ 440	KEKEASHQLK LELNSMQEQL 940	
RQLSSEKLMD KEQQVADLQL 460	IQAQNTLKQN EKEEQQLQGN 960	
KLSRLEEQLK EKVTNSTELQ 480	INELKQSSEQ KKKQIEALQG 980	
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Supplemental Figure 4. MST1 mass spectrometry data

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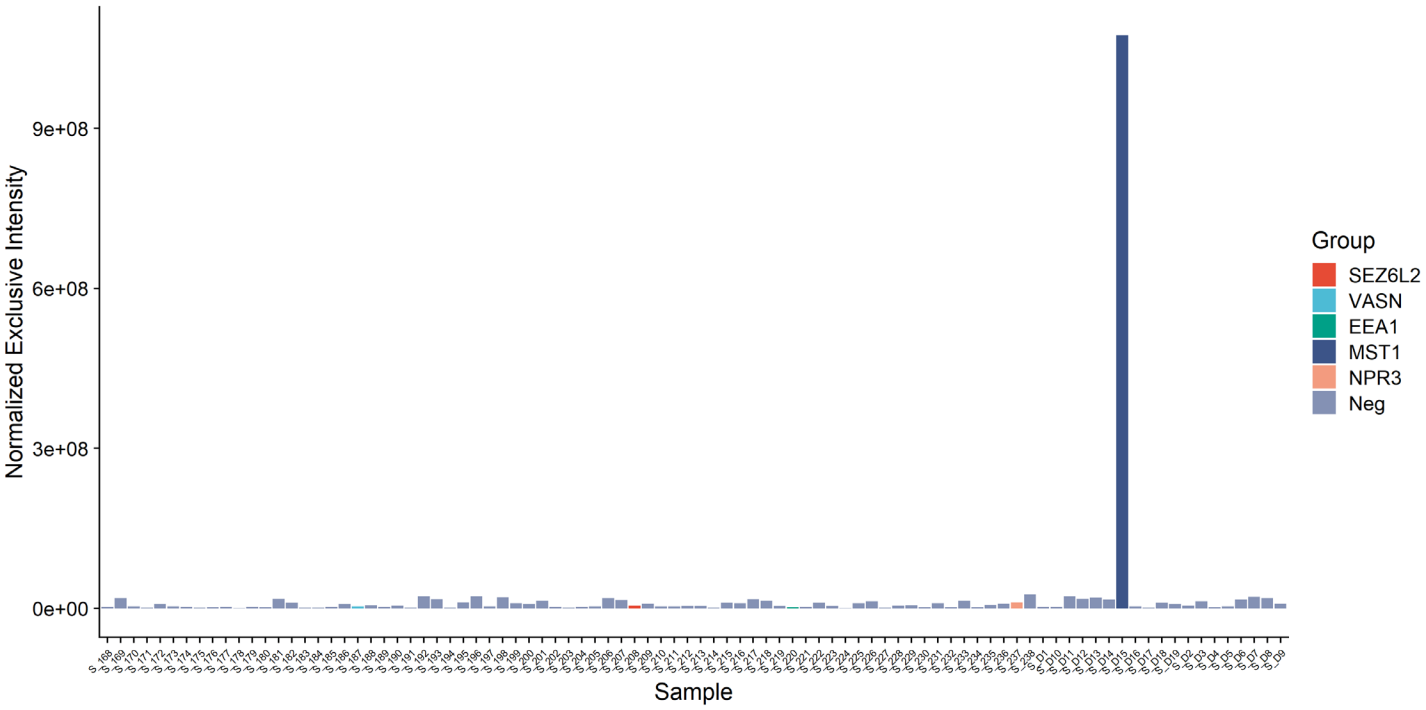

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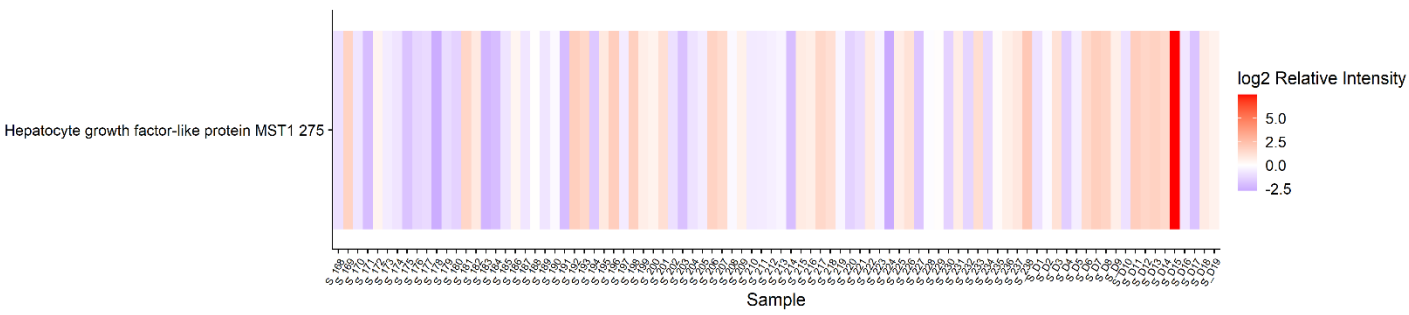

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L P W T Q H S P H T   R L R R S G R C D L   F Q K K D Y V R T C   I M N N G V G Y R G   120
                                                        (M)
T M A T T V G G L P   C Q A W S H K F P N   D H K Y T P T L R N   G L E E N F C R N P   160
                                          (M)       (M)
D G D P G G P W C Y   T T D P A V R F Q S   C G I K S C R E A A   C V W C N G E E Y R   200
                                                                (M)
G A V D R T E S G R   E C Q R W D L Q H P   H Q H P F E P G K F   L D Q G L D D N Y C   240
                  (M)                       (M)
R N P D G S E R P W   C Y T T D P Q I E R   E F C D L P R C G S   E A Q P R Q E A T T   280
    (M)
V S C F R G K G E G   Y R G T A N T T T A   G V P C Q R W D A Q   I P H Q H R F T P E   320
                                                    (M)
K Y A C K D L R E N   F C R N P D G S E A   P W C F T L R P G M   R A A F C Y Q I R R   360
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V C G P S G S Q L V   L L K L E R S V T L   N Q R V A L I C L P   P E W Y V V P P G T   600
    (M)
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Supplemental Figure 5. NPR3 mass spectrometry data

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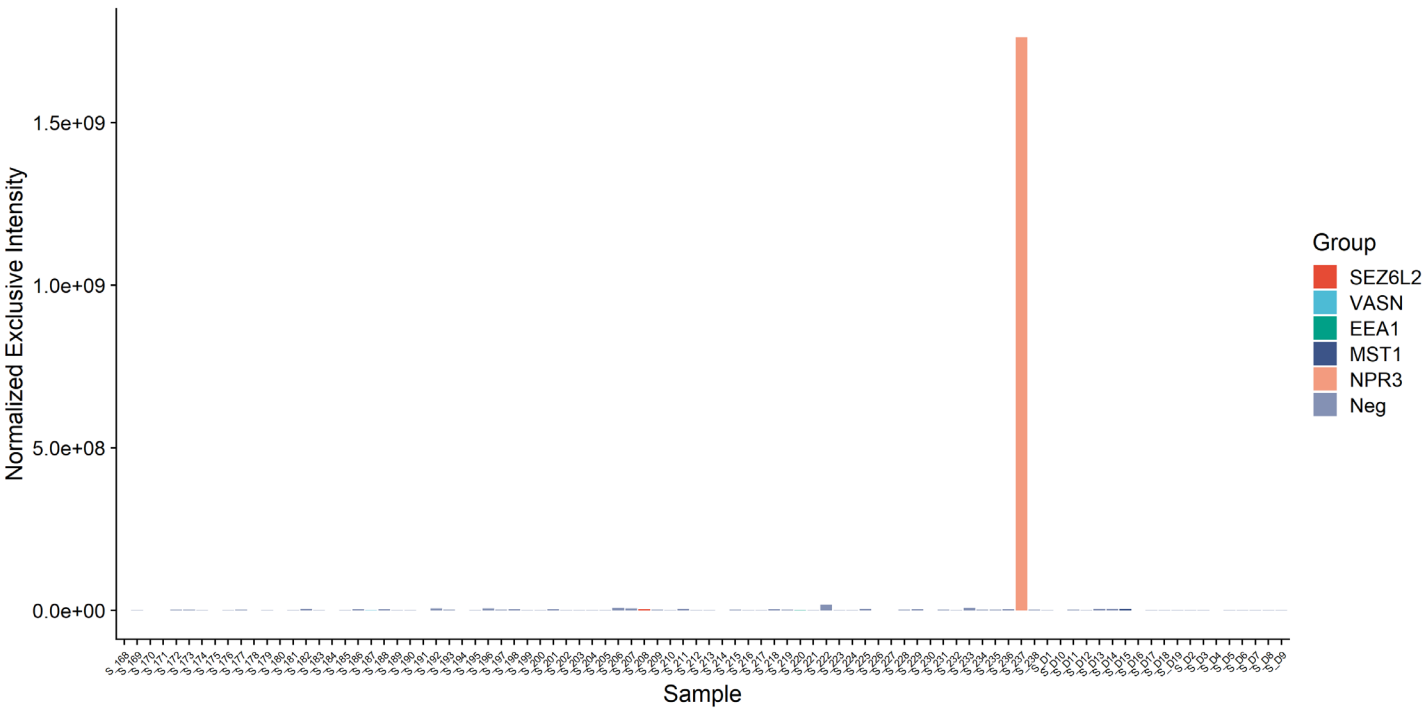

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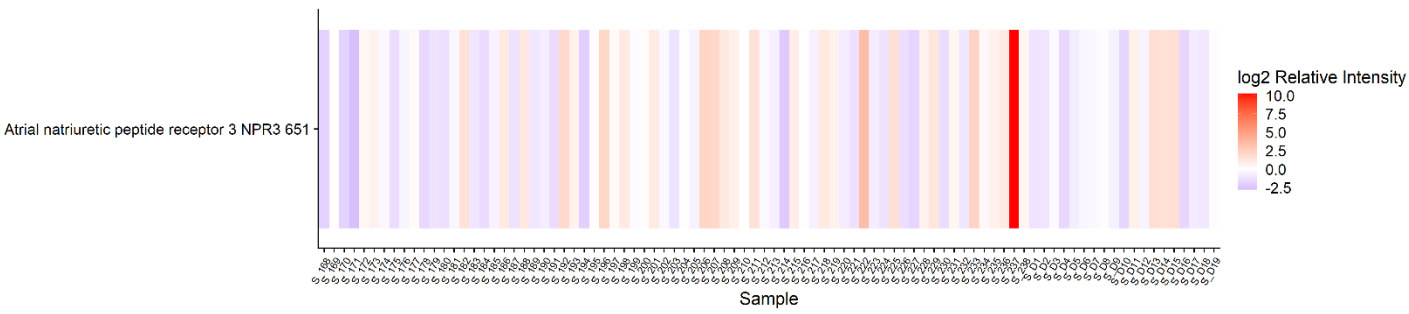

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Supplemental Figure 6. FCN3 mass spectrometry data

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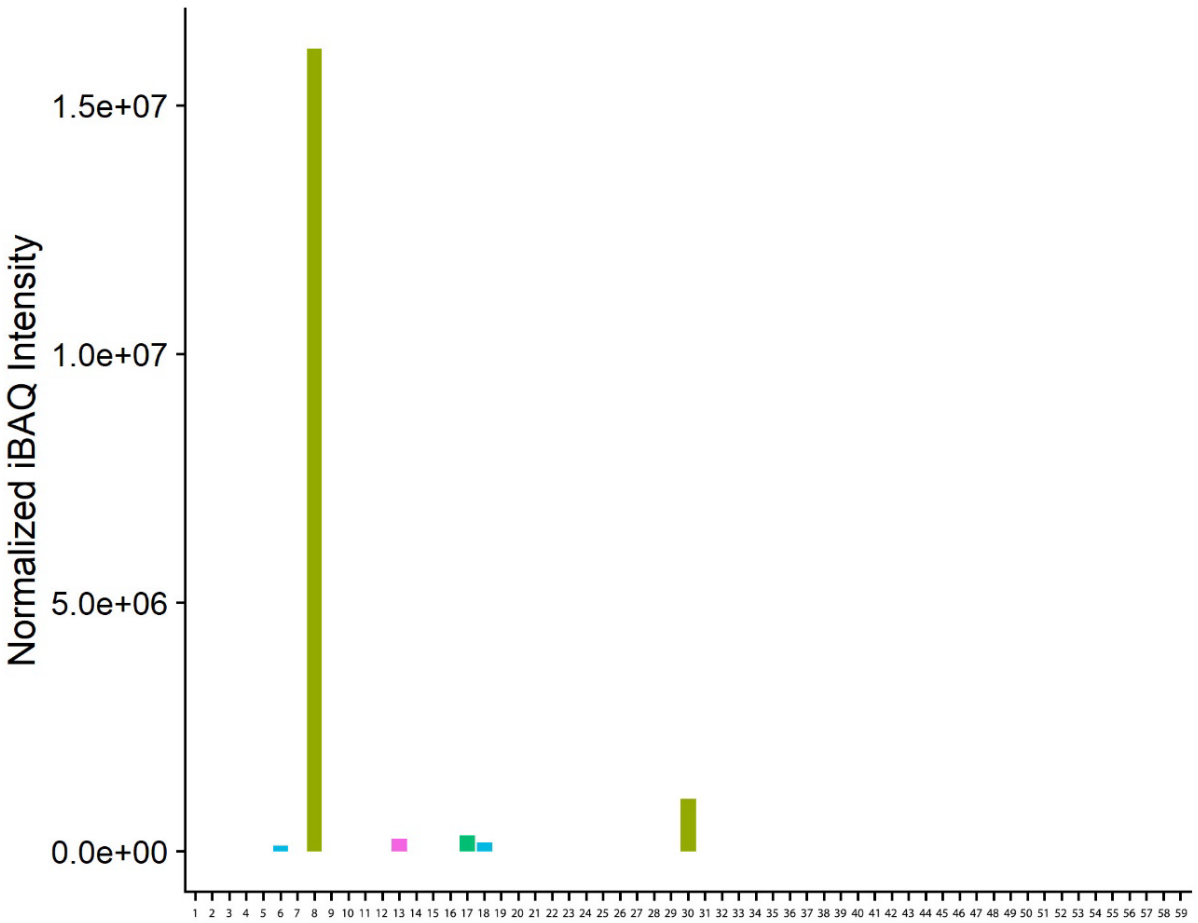

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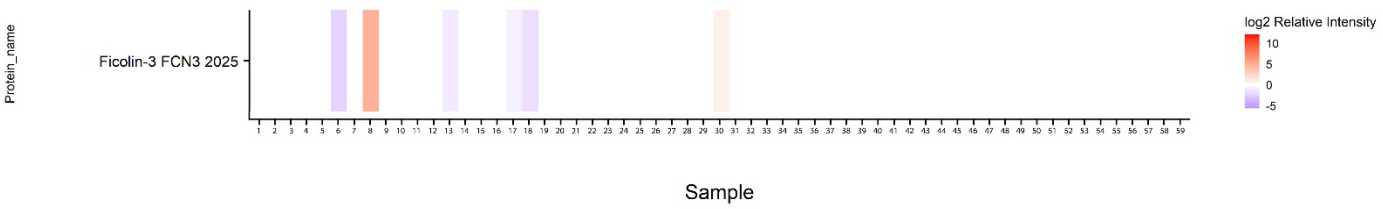

C

O75636, 32,903.3 Da
Ficolin-3 OS=Homo sapiens OX=9606 GN=FCN3 PE=1 SV=2
7 exclusive unique peptides, 10 exclusive unique spectra, 14 total spectra, 86/299 amino acids (29% coverage)

M D L L W I L P S L W L L L L G G P A C L K T Q E H P S C P G P R E L E A S K V
V N L L R C Q E G P R N C R E L L S Q G A T L S G W Y H L C L P E G R A L P V F
F W L G N E N L H Q L T L Q G N W E L R V E L E D F N G N R T F A H Y A T F R L
S N S N C A V I V H G A W W Y A S C Y R S N L N G R Y A V S E A A A H K Y G I D

V L L P S C P G A P G S P G E K G A P G P Q G P P G P P G K M G P K G E P G D P
C D M D T E G G G W L V F Q R R Q D G S V D F F R S W S S Y R A G F G N Q E S E
L G E V D H Y Q L A L G K F S E G T A G D S L S L H S G R P F T T Y D A D H D S
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Supplemental Figure 7. CD206 mass spectrometry data

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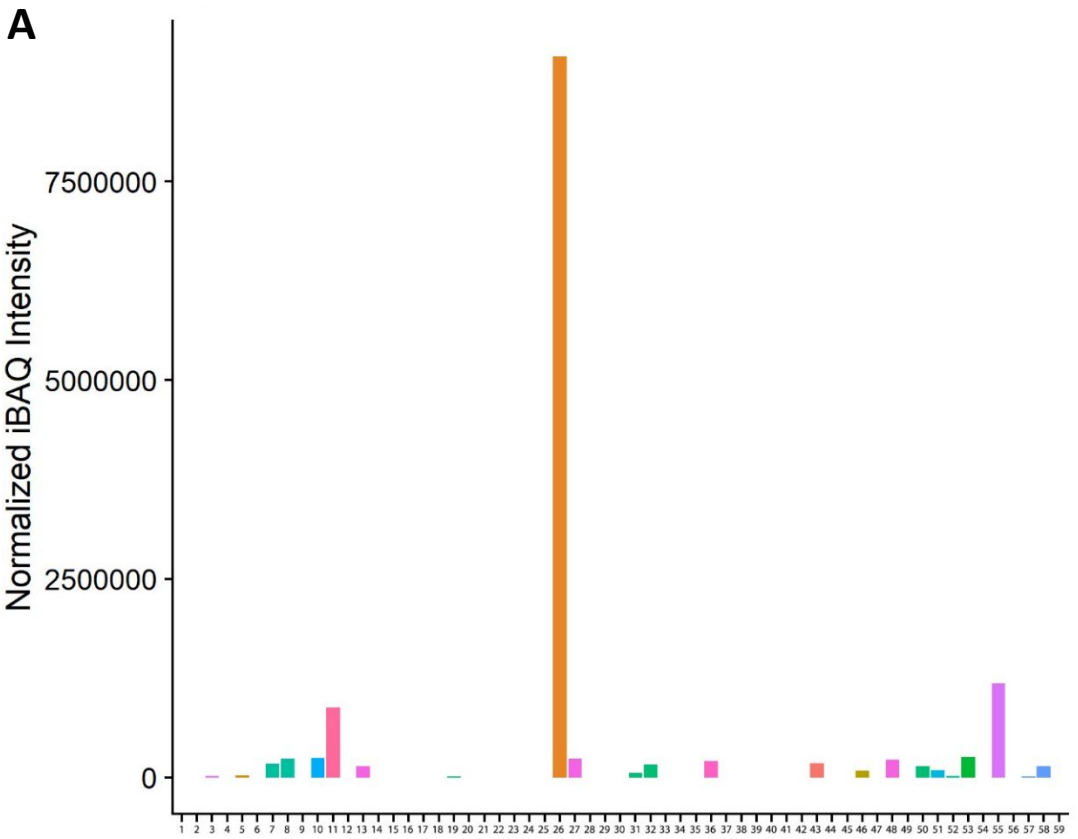

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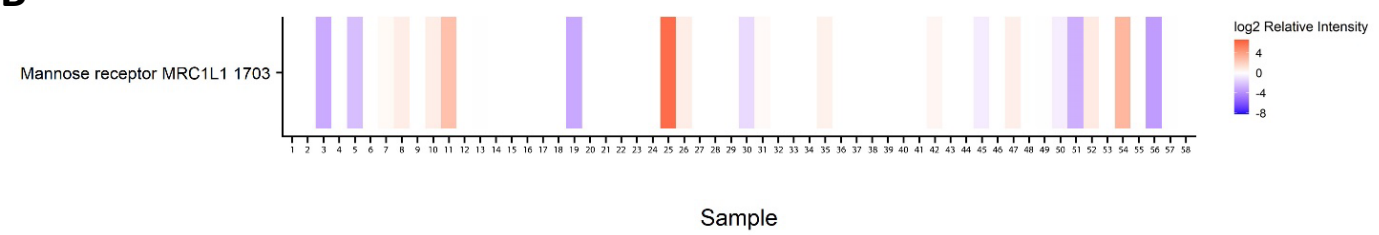
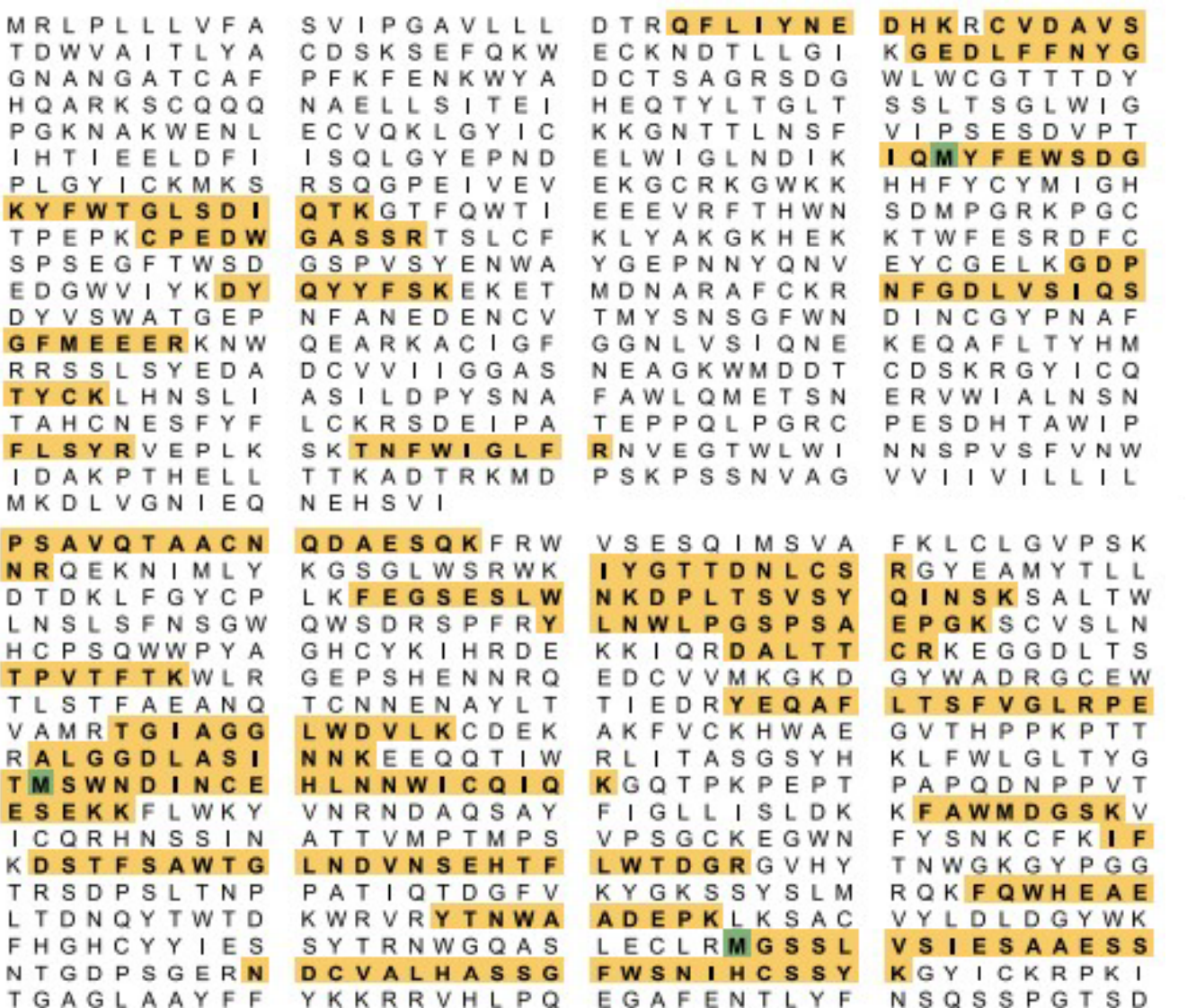
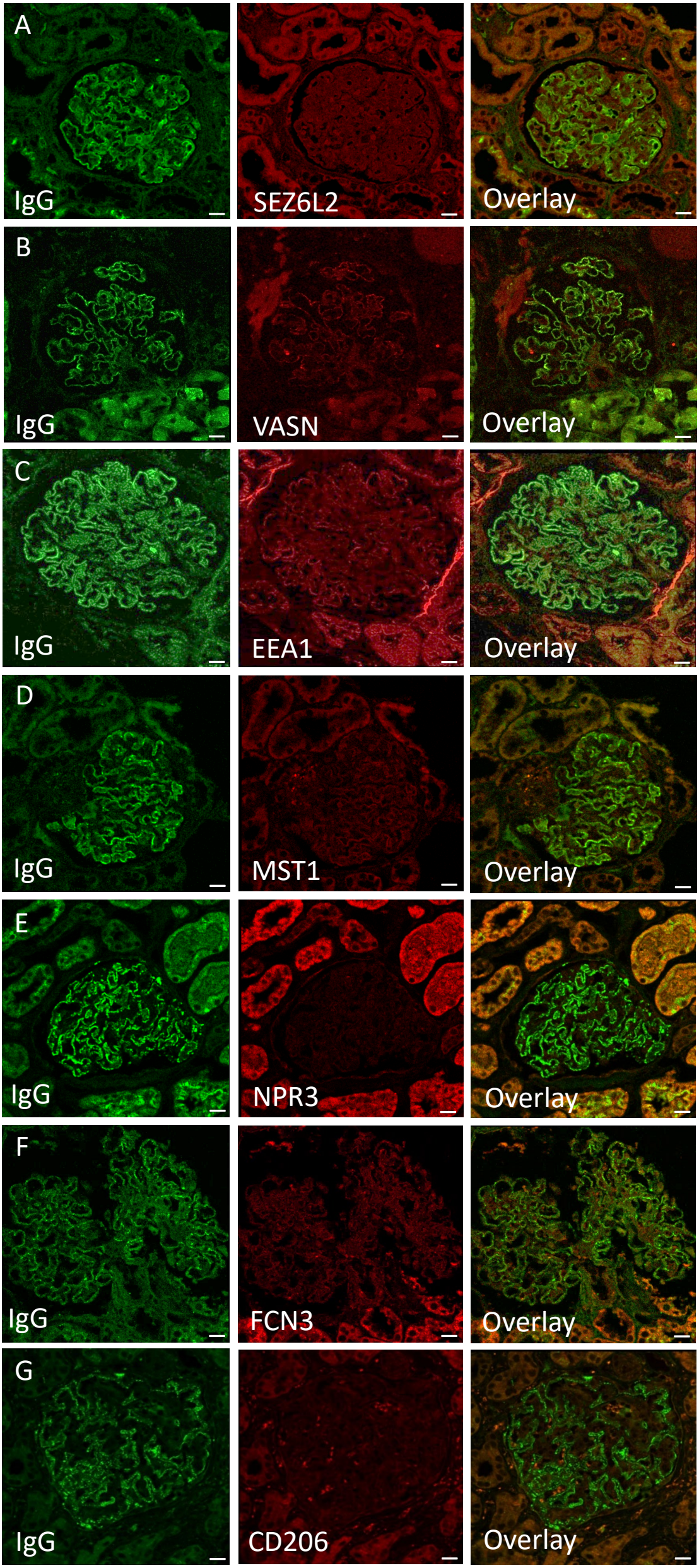


C

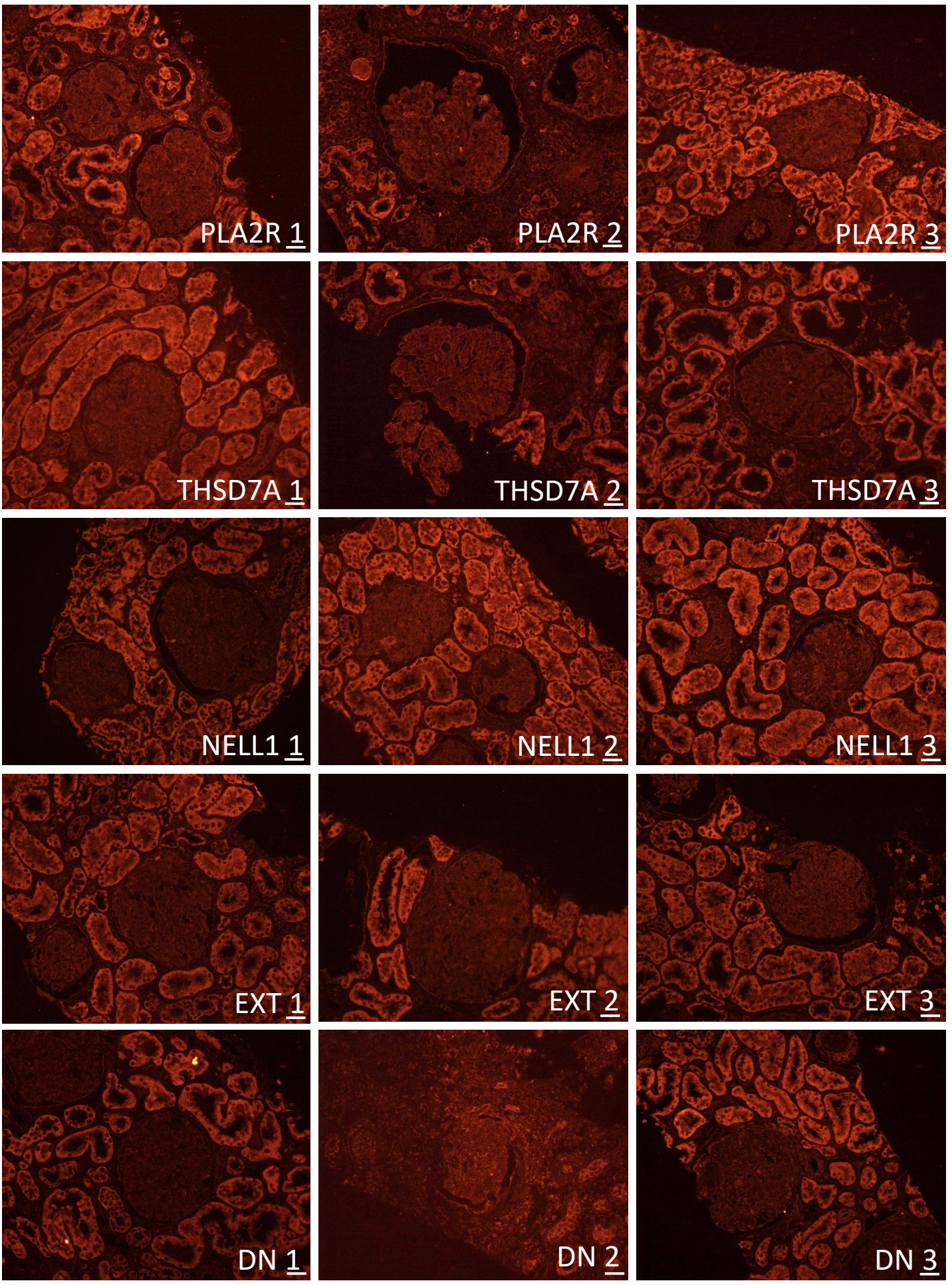
P22897, 166,014.7 Da
Macrophage mannose receptor 1 OS=Homo sapiens OX=9606 GN=MRC1 PE=1 SV=1
26 exclusive unique peptides, 30 exclusive unique spectra, 33 total spectra, 340/1456 amino acids (23% coverage)



Supplemental Figure 8.

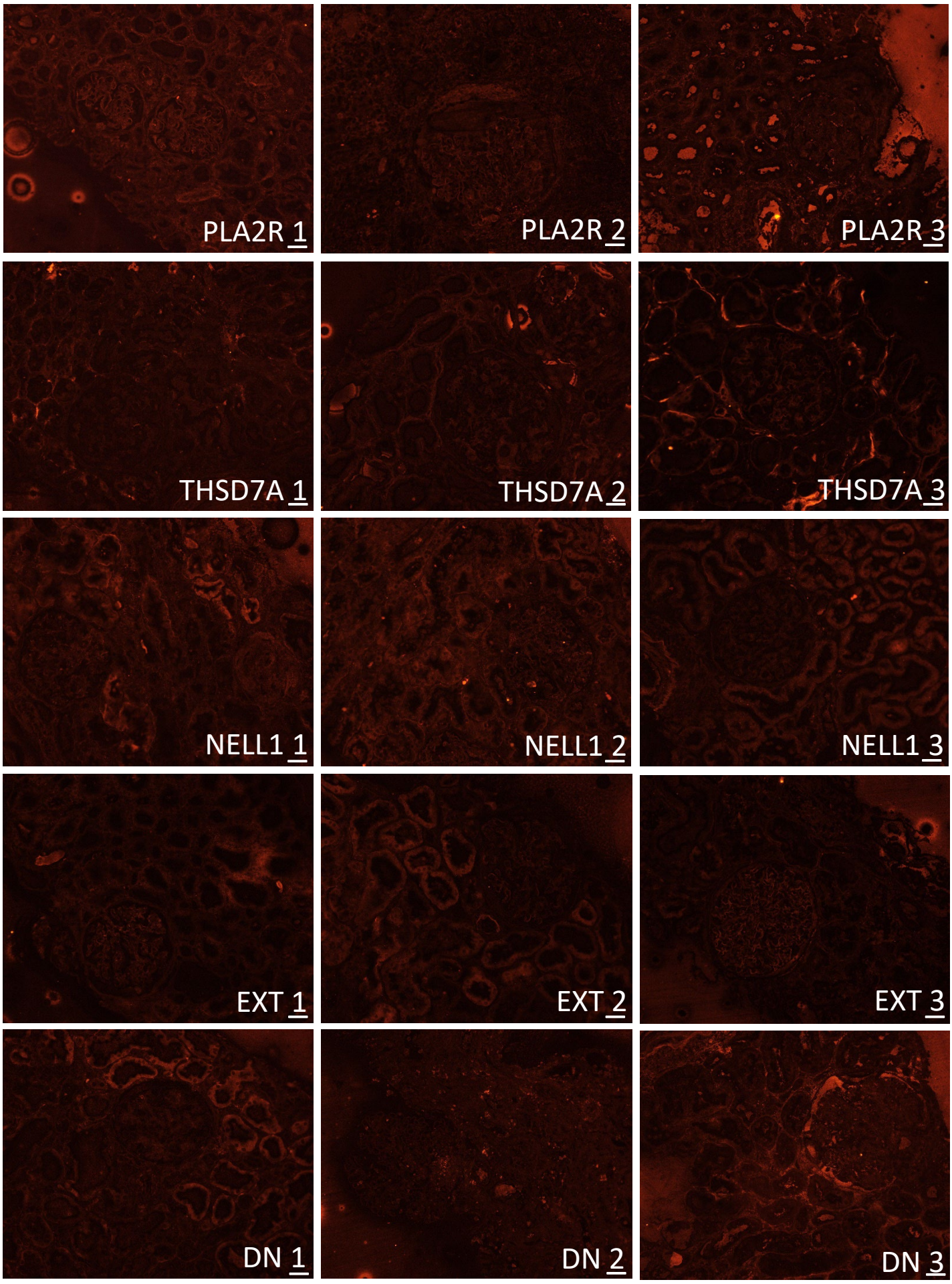


Supplemental Figure 9. Paraffin immunofluorescence staining of PLA2R, THSD7A, EXT1/2, NELL1, and diabetic nephropathy biopsies as negative controls for each candidate antigen. **A) SEZ6L2**; B) VASN; C) EEA1; D) MST1; E) NPR3; F) FCN3; G) CD206. Scale bar = 20 µm.



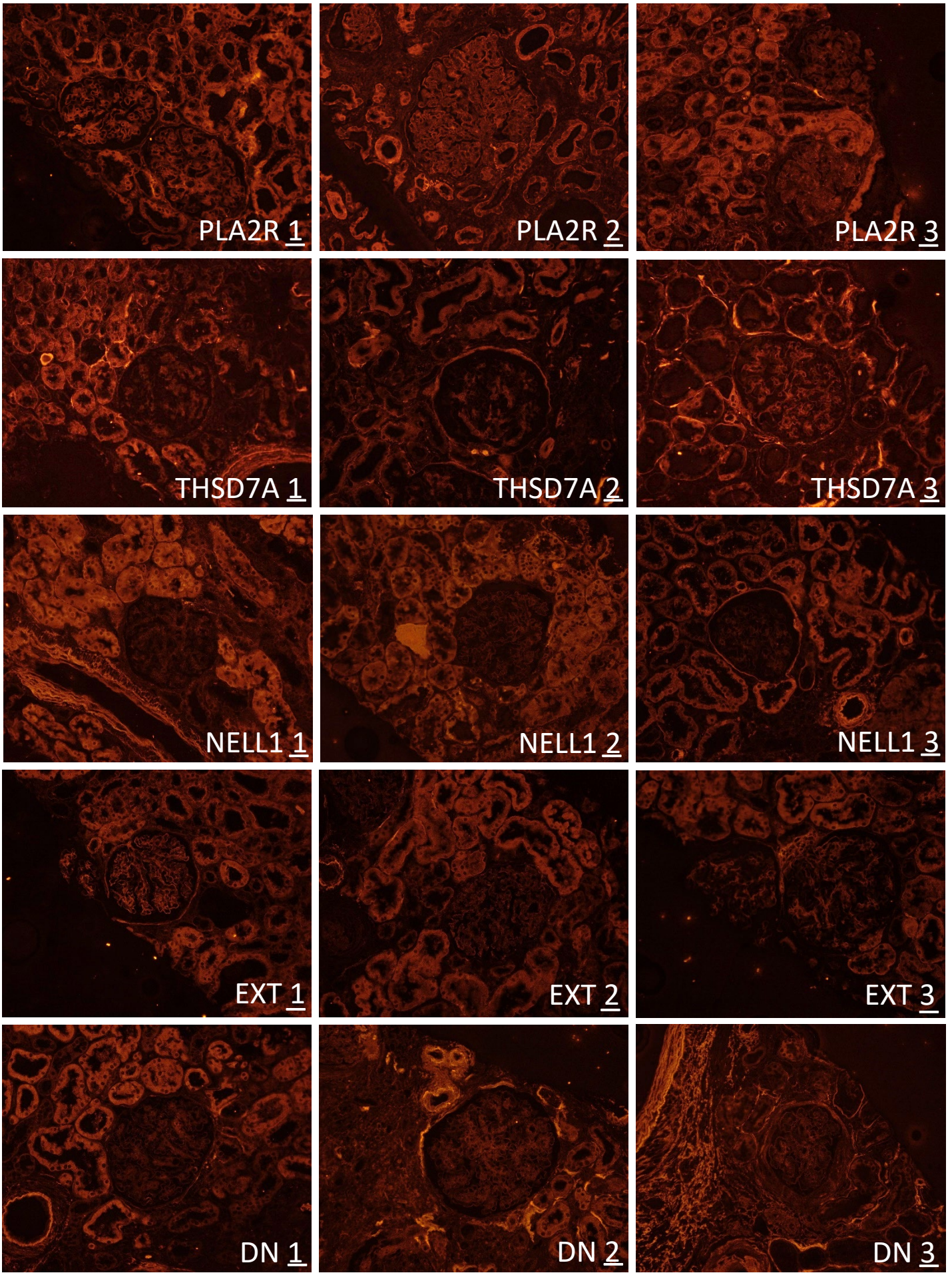
Negative controls for SEZ6L2 immunofluorescence staining

Supplemental Figure 9. Paraffin immunofluorescence staining of PLA2R, THSD7A, EXT1/2, NELL1, and diabetic nephropathy biopsies as negative controls for each candidate antigen. A) SEZ6L2; **B) VASN**; C) EEA1; D) MST1; E) NPR3; F) FCN3; G) CD206. Scale bar = 20 μm.



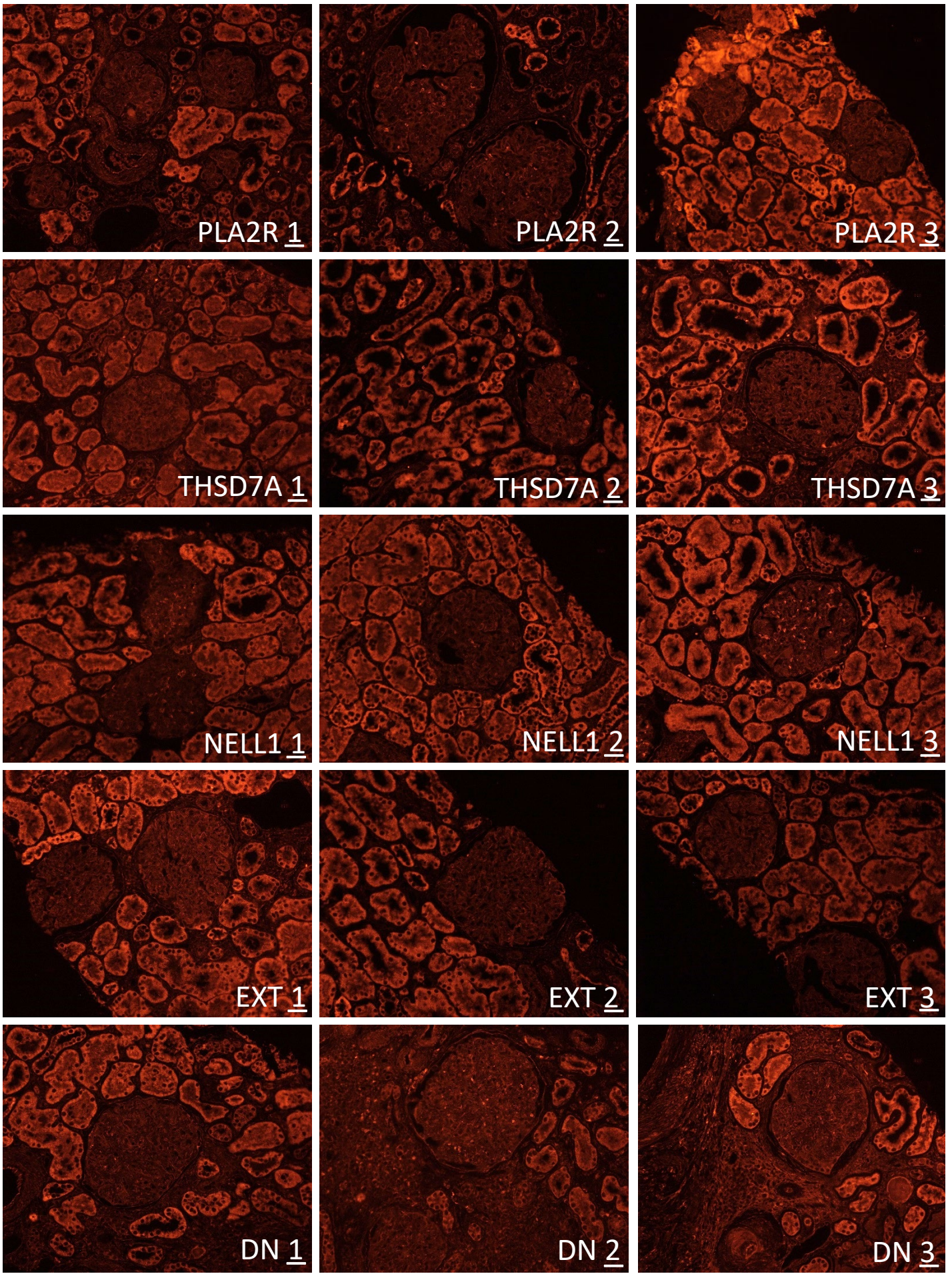
Negative controls for VASN immunofluorescence staining

Supplemental Figure 9. Paraffin immunofluorescence staining of PLA2R, THSD7A, EXT1/2, NELL1, and diabetic nephropathy biopsies as negative controls for each candidate antigen. A) SEZ6L2; B) VASN; **C) EEA1**; D) MST1; E) NPR3; F) FCN3; G) CD206. Scale bar = 20 µm.



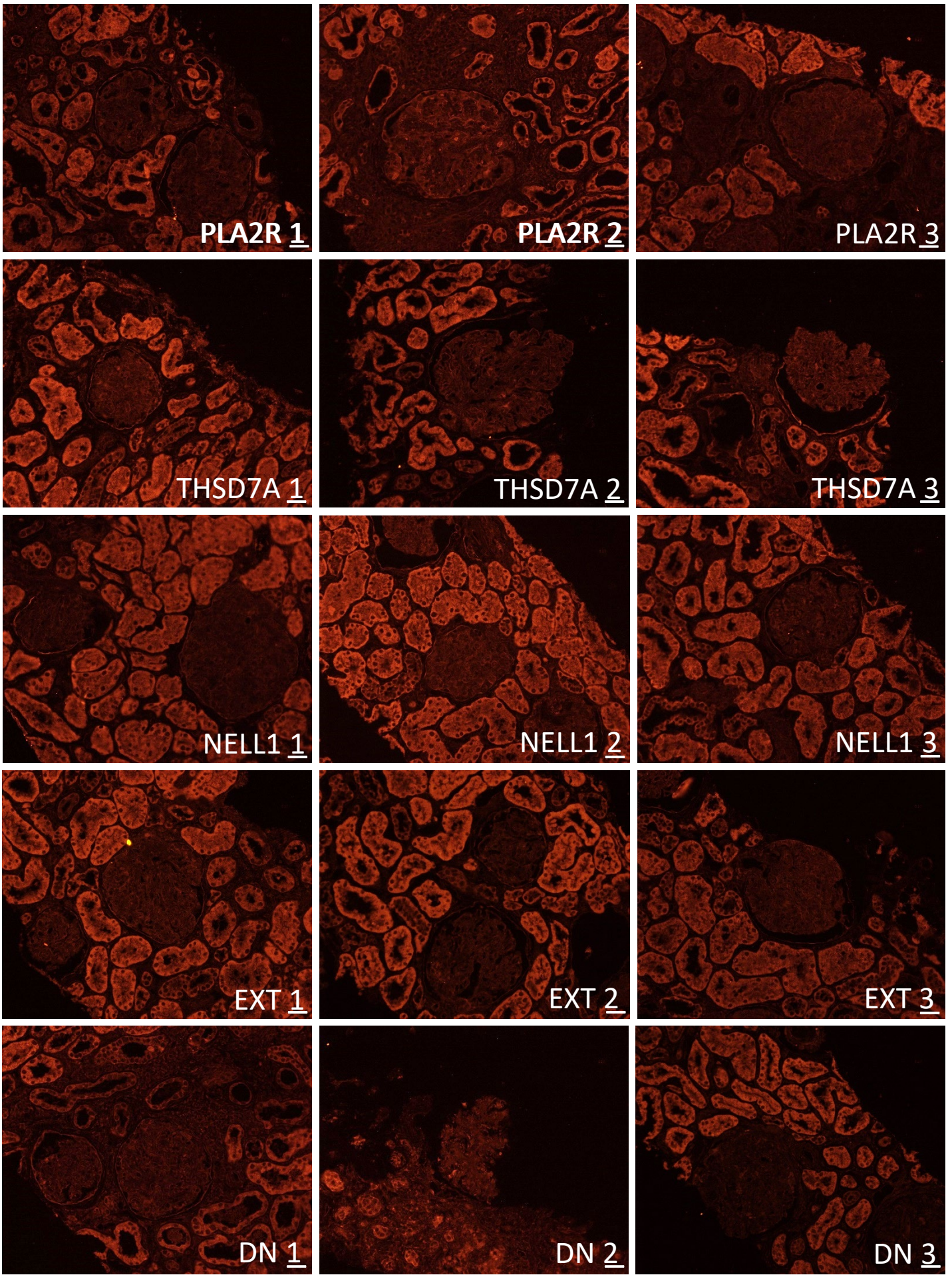
Negative controls for EEA1 immunofluorescence staining

Supplemental Figure 9. Paraffin immunofluorescence staining of PLA2R, THSD7A, EXT1/2, NELL1, and diabetic nephropathy biopsies as negative controls for each candidate antigen. A) SEZ6L2; B) VASN; C) EEA1; **D) MST1**; E) NPR3; F) FCN3; G) CD206. Scale bar = 20 µm.



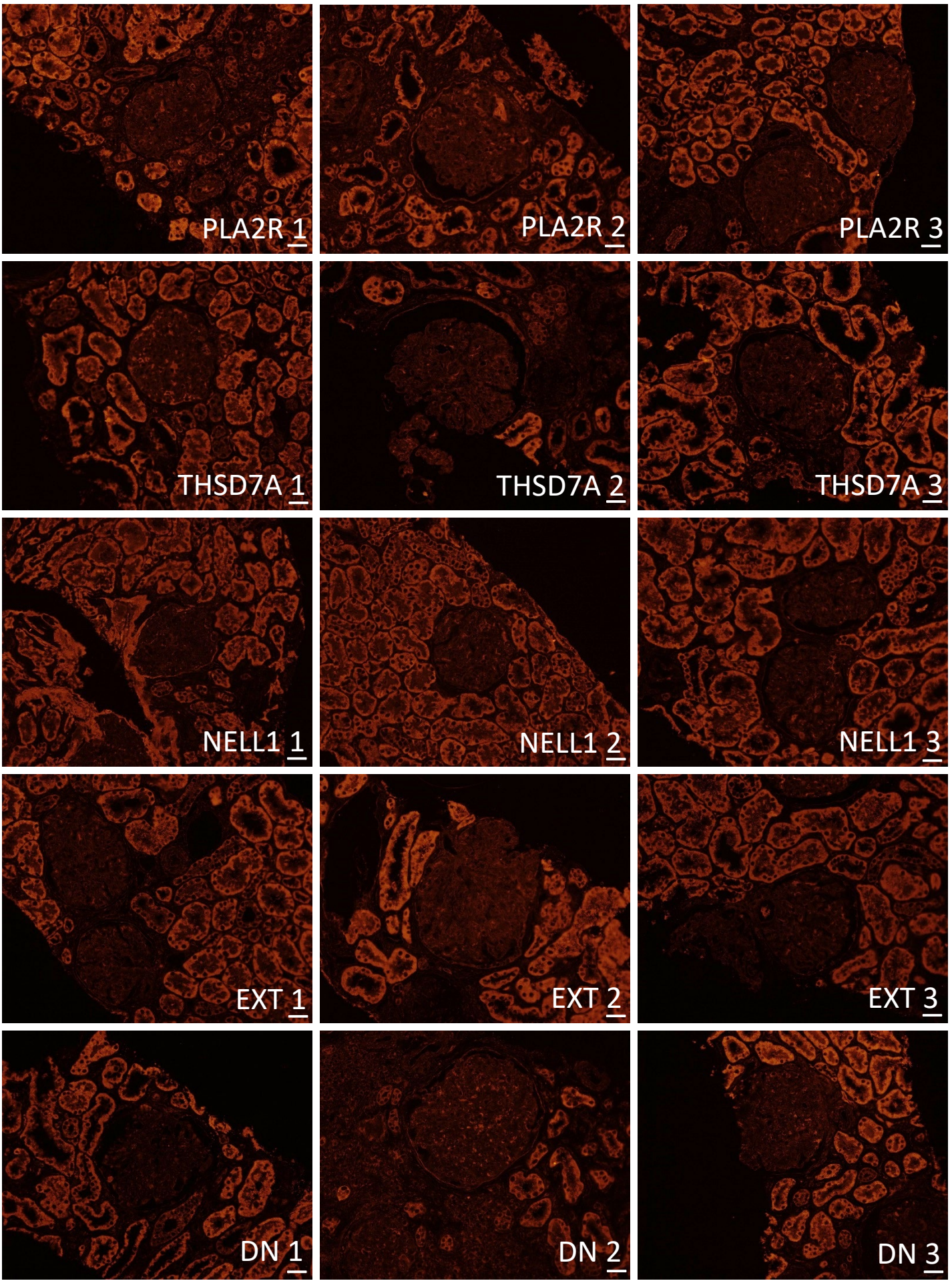
Negative controls for MST1 immunofluorescence staining

Supplemental Figure 9. Paraffin immunofluorescence staining of PLA2R, THSD7A, EXT1/2, NELL1, and diabetic nephropathy biopsies as negative controls for each candidate antigen. A) SEZ6L2; B) VASN; C) EEA1; D) MST1; **E) NPR3**; F) FCN3; G) CD206. Scale bar = 20 µm.



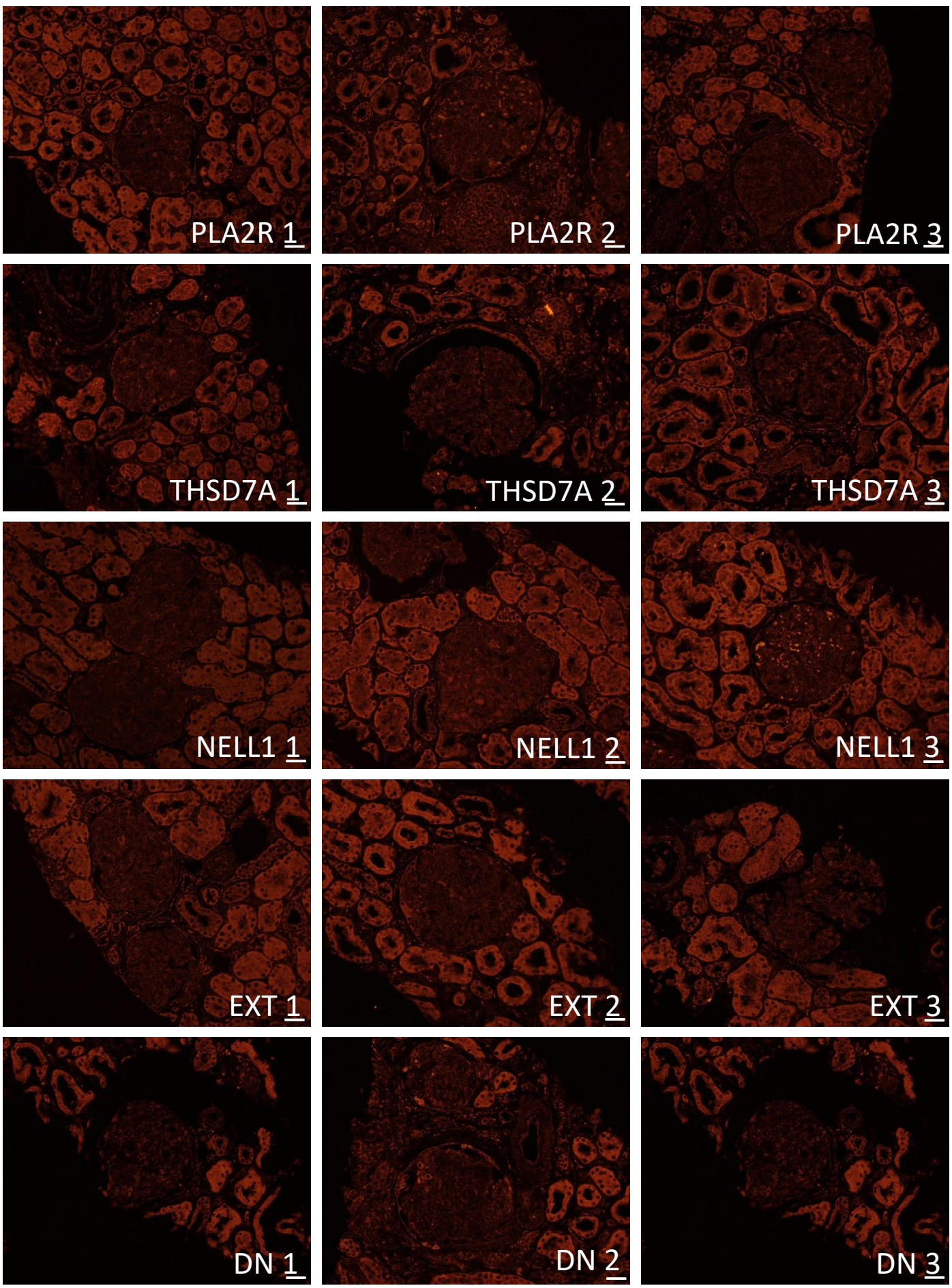
Negative controls for NPR3 immunofluorescence staining

Supplemental Figure 9. Paraffin immunofluorescence staining of PLA2R, THSD7A, EXT1/2, NELL1, and diabetic nephropathy biopsies as negative controls for each candidate antigen. A) SEZ6L2; B) VASN; C) EEA1; D) MST1; E) NPR3; **F) FCN3**; G) CD206. Scale bar = 20 µm.



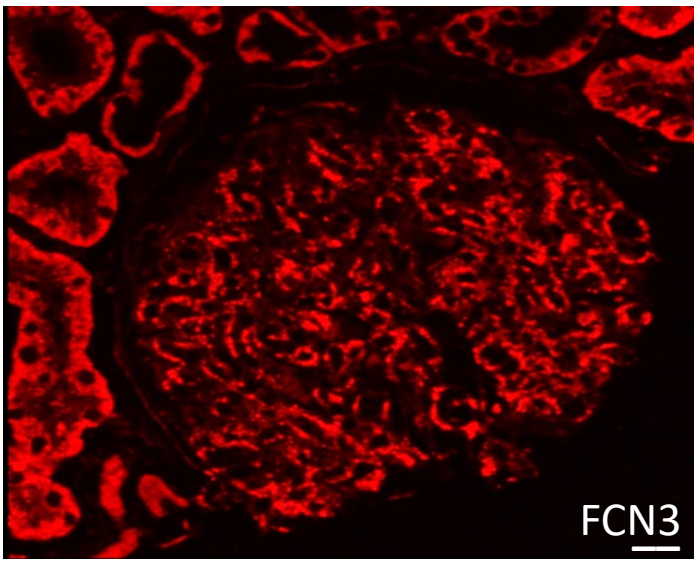
Negative controls for FCN3 immunofluorescence staining

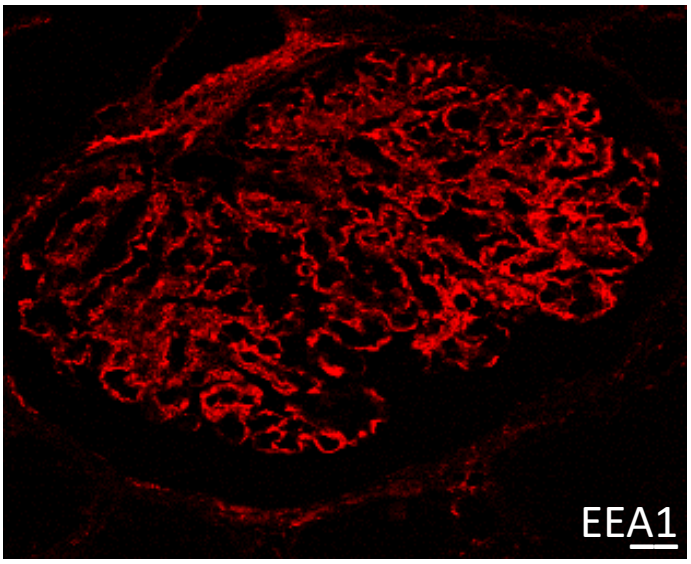
Supplemental Figure 9. Paraffin immunofluorescence staining of PLA2R, THSD7A, EXT1/2, NELL1, and diabetic nephropathy biopsies as negative controls for each candidate antigen. A) SEZ6L2; B) VASN; C) EEA1; D) MST1; E) NPR3; F) FCN3; **G) CD206**. Scale bar = 20 µm.

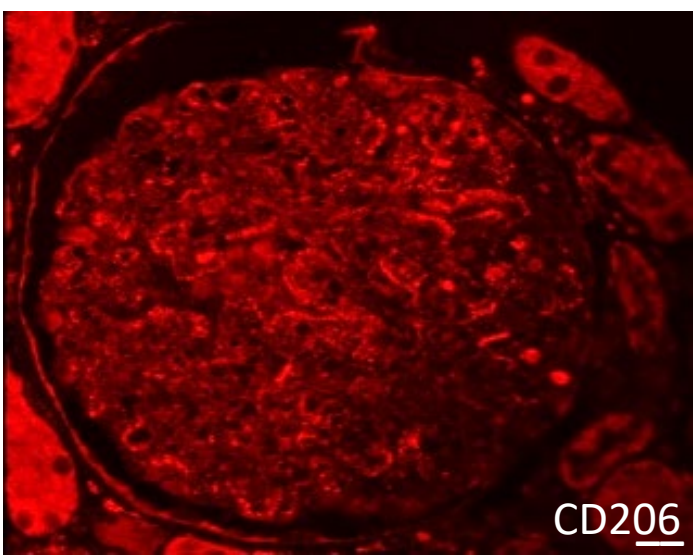


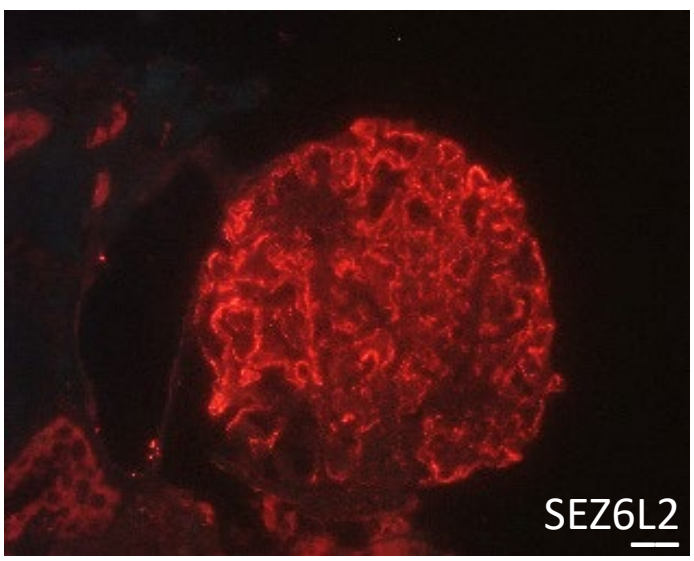
Negative controls for CD206 immunofluorescence staining

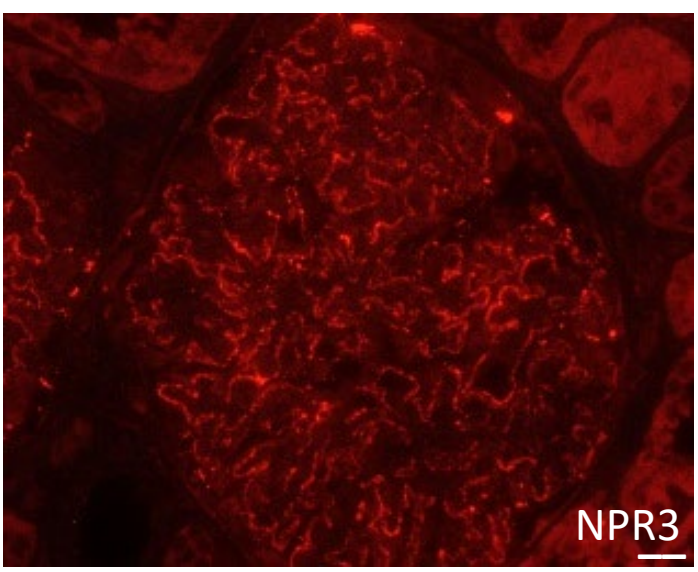
Supplemental Figure 10. Representative paraffin immunofluorescence images for the putative antigens.

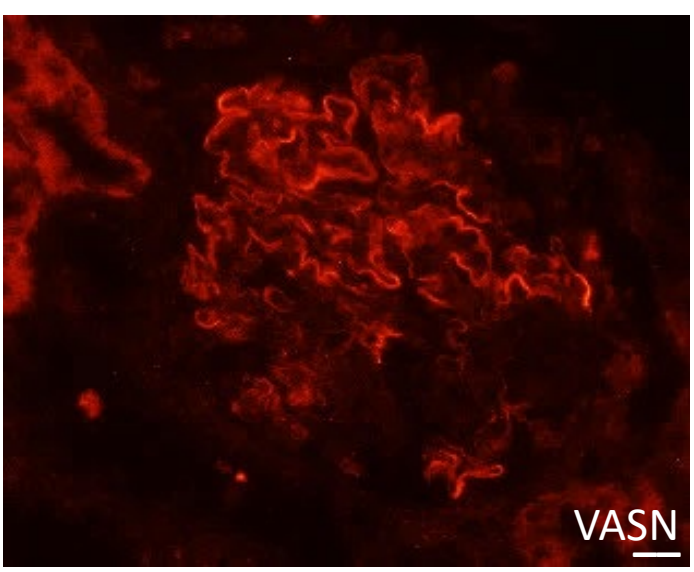


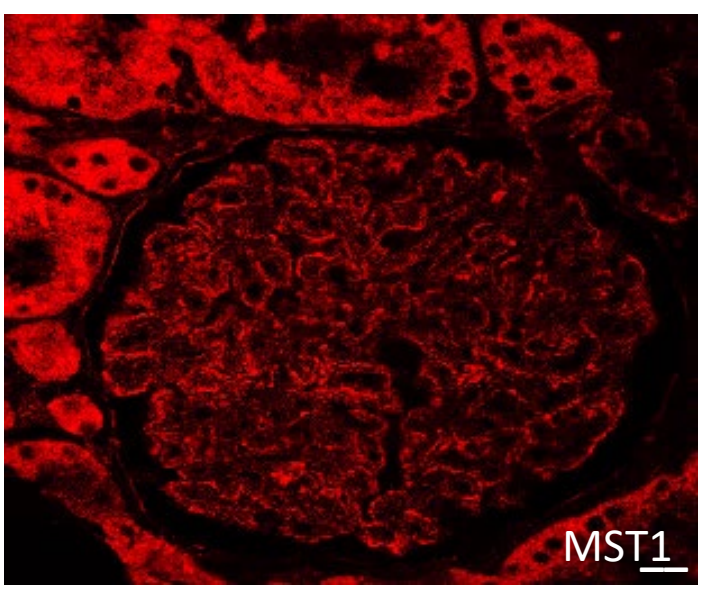












Case	Biomarker	Lupus?	Age	Sex	Cr	Prot	IgA	IgG	IgM	C3	C1q	TBM deposits	Mesangial deposits	Subendo deposits	Medical conditions
1	FCN3	Yes	51	F	Unk	Unk	1	3	0	1	2	0	1	1	SLE, HTN
2	FCN3	Yes	56	F	1.1	3.8	1	3	4	4	2	0	1	1	SLE
3	FCN3	Yes (III + V)	44	M	3.2	NR	1	2	1	2	1	1	1	1	SLE, HTN, ITP, APLS
4	FCN3	No	47	M	1.3	3+	0	3	0	3	0	0	1	0	Untreated HBV
5	FCN3	Yes (III + V)	22	F	1	1	3	3	0	2	1	0	1	1	SLE, HTN, IUFD
6	FCN3	Yes	27	F	WNL	1.9	0	3	2	1	T	1	1	N/A (no EM)	SLE, HTN, DM, obesity
7	EEA1	No	55	M	1.4	8.8	1	3	0	3	0	0	0	0	None
8	EEA1	No	31	F	0.6	6	0	3	1	1	0	0	0	0	None
9	EEA1	No	64	F	WNL	5	0	3	0	2	0	0	0	1	HTN, hyperlipidemia, obesity
10	EEA1	Yes (III + V)	22	F	2.7	2.1	0	3	0	0	0	0	1	N/A	SLE
11	EEA1	No	32	M	1.7	NR	0	3	0	2	0	0	1	0	HTN, HIV, syphilis
12	EEA1	Yes	50	F	1.2	Unk	0	2	1	1	0	0	1	0	SLE, rheumatoid arthritis
13	EEA1	No	33	M	1.3	NR	T	2	T	2	0	0	0	0	HTN, schizophrenia, smoking
14	EEA1	Yes	45	F	Unk	Unk	2	3	2	1	2	0	1	1	SLE
15	EEA1	Yes	38	F	5.8	3.8	T	3	0	3	0	0	1	1	SLE, APLS, ITP, HTN, PE
16	EEA1	Yes	28	F	0.6	1.9	0	3	0	2	1	0	1	0	SLE, PE, PRES, HTN, seizures
17	EEA1	Yes	40	F	0.6	0.8	1	3	1	2	1	0	1	0	SLE
18	EEA1	Yes	56	M	1.4	Unk		3	3	3	3	0	1	0	SLE, APLS, smoking

19	EEA1	No	68	F	0.5	2+	0	3	0	3	0	0	1	0	Osteoarthritis, HTN, chronic pain
20	CD206 (index case)	No	67	F	2.1	3	T	3	0	T	0	0	1	0	Atheroemboli, scleroderma, HTN, pulmonary HTN
21	SEZ6L2	No	79	M	1.4	2	0	3	0	T	0	0	0	0	HTN, BPH, GERD, DJD
22	SEZ6L2 (index case)	No	64	M	0.9	NR	0	3	0	0	0	0	0	0	HTN
23	NPR3 (index case)	No	62	F	1	4	0	3	0	2	0	0	1	0	HTN, glucose intolerance, abdominal mass
24	VASN (index case)	No	20	F	Unk	NR	0	3	0	3	0	0	1	0	None
25	VASN	Yes	41	F	0.7	Unk	0	3	0	0	0	0	1	0	SLE
26	VASN	Yes	21	F	0.8	0.8	2	3	0	1	1	1	1	0	SLE
27	VASN	No	44	F	0.6	6.7	0	3	0	2	0	0	1	0	None
28	VASN	No	38	F	0.8	2+	0	3	0	0	0	0	0	0	RVT
29	VASN	No	66	M	1.4	NR	0	2	0	2	0	0	0	0	Gout, scrotal cellulitis, arthritis, hyperlipidemia
30	VASN	No	47	M	WNL	NR	0	3	2	1	1	0	1	1	Seizures, bipolar disorder, substance abuse, ANA+
31	VASN	No	84	F	1.3	4.9	0	3	0	3	0	1	1	0	HTN, hypothyroidism, DJD
32	VASN	No	21	M	Unk	NR	1	3	2	2	2	0	0	0	None

33	VASN	No	34	F	0.6	8.9	3	3	T	1	0	0	1	0	ANA positive, PE
34	VASN	Yes	32	F	Unk	Unk	1	3	1	1	1	1	1	0	SLE
35	VASN	Yes	46	F	1.8	Unk	1	3	1	2	2	1	1	1	SLE
36	MST1	No	21	F	0.5	9.5	0	3	0	2	0	0	0	0	HTN, 22 wk pregnancy, renal calculi
37	MST1	No	22	F	0.9	NR	3	3	1	1	0	1	0	0	HTN, DVT, ANA/dsDNA positive
38	MST1	No	51	F	Unk	2.8	0	3	0	1	0	0	0	0	HTN, MGUS
39	MST1 / VASN	Yes	32	F	0.6	1.9	1	2	1	2	2	1	1	1	SLE, GERD
40	MST1	No	64	F	0.6	Unk	0	3	T	0	0	0	0	1	HTN, GERD, COPD, ANA positive
41	MST1 (index case)	No	38	F	Unk	2+	0	3	0	3	0	0	1	0	NSAID use, obesity
42	MST1	No	67	M	Unk	1.5	1	3	0	1	0	0	0	0	Pulmonary nodules
43	MST1	Yes	24	M	0.8	Unk	2	3	2	2	1	1	1	0	SLE

Supplemental Table S1. Clinical and pathologic characteristics of MN patients positive for identified biomarkers.

Abbreviations: ANA, antinuclear antibodies; APLS, anti-phospholipid antibody syndrome; BPH, benign prostatic hypertrophy; COPD, chronic obstructive pulmonary disease; Cr, creatinine; DJD, degenerative joint disease/osteoarthritis; DM, diabetes mellitus; DVT, deep venous thrombosis; F, female; GERD, gastroesophageal reflux disease; HTN, hypertension; ITP, immune thrombocytopenic purpura; IUFD, intrauterine fetal demise; M, male; MGUS, monoclonal gammopathy of undetermined significance; NR, nephrotic range; N/A, not applicable/not available; NSAIDs, non-steroidal anti-inflammatory drugs; prot, proteinuria; PRES, posterior reversible encephalopathy syndrome; PE, pulmonary embolism; RA, rheumatoid arthritis; RVT, renal vein thrombosis; SLE, systemic lupus erythematosus; subendo, subendothelial deposits; TBM, tubular basement membrane; TIA, transient ischemic attack; WNL, within normal limits

Case	Biomarker	MN or MLN	IgG1	IgG2	IgG3	IgG4
2	FCN3	MLN	3	0	0	T
6	FCN3	MLN	3	3	2	3
9	EEA1	MN	3	0	0	0
10	EEA1	MLN	3	1	1	0
12	EEA1	MN	0	1	0	3
13	EEA1	MN	3	3	0	3
15	EEA1	MLN	0	2	0	0
17	EEA1	MLN	2	1	0	0
18	EEA1	MLN	2	3	0	0
21	SEZ6L2	MN	2	0	0	3
29	VASN	MN	2	0	0	0
30	VASN	MN	3	3	3	3
31	VASN	MN	3	3	0	3
32	VASN	MN	3	0	3	0
36	MST1	MN	3	1	0	2
37	MST1	MN	3	3	0	3
39	MST1/VASN	MLN	3	3	3	0

Supplemental Table S2. IgG subclass staining of biopsies positive for candidate antigens.